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ESCAPE OF MARS ATMOSPHERIC CARBON THROUGH TIME BY PHOTOCHEMICAL MEANS. J. G. Luhmann¹, J. Kim², and A. F. Nagy³, ¹Institute of Geophysics and Planetary Physics, University of California, Los Angeles CA 90024-1567, USA, ²KARI, Seoul, Korea, ³Space Research Laboratory, University of Michigan, Ann Arbor MI 48109, USA.

Luhmann et al. [1] recently suggested that sputtering of the martian atmosphere by reentering O⁺ pickup ions could have provided a significant route of escape for CO₂ and its products throughout Mars' history. They estimated that the equivalent of C in a ~140-mbar CO₂ atmosphere should have been lost this way if the Sun and solar wind evolved according to available models. Another source of escaping C (and O) that is potentially important is the dissociative recombination of ionospheric CO⁺ near the exobase [2]. We have evaluated the loss rates due to this process for "ancient" solar EUV radiation fluxes of 1, 3, and 6× the present flux in order to calculate the possible cumulative loss over the last 3.5 Gyr. (Earlier estimates of loss by McElroy [2] used the present-day rates and thus represent underestimates.) The inputs and assumptions for this calculation are the same as used by Zhang et al. [3] for an evaluation of historical O escape by dissociative recombination of ionospheric O₂⁺. We find loss rates of C that are at least comparable to the sputtering loss rates, thereby potentially accounting for another 100 mbar or more of Mars' original atmosphere.

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MIGHT IT BE POSSIBLE TO PREDICT THE ONSET OF MAJOR MARTIAN DUST STORMS? L. J. Martin¹, P. B. James², and R. W. Zurek³, ¹Lowell Observatory, Flagstaff AZ 86001, USA, ²University of Toledo, Toledo OH 43606, USA, ³Jet Propulsion Laboratory and California Institute of Technology, Pasadena CA 91109, USA.

This was done very successfully by the late "Chick" Capen in 1971, but we now believe that the chance of having a planet-encircling storm in any given Mars year is less than 50% [1]. Capen suggested that these storms begin around the time of perihelion. More recent storms have extended this season to nearly one-third of a martian year, during the same interval that the south polar cap is receding [2]. There is no observational evidence that storms of this size have occurred outside of that period, although smaller dust storms have been observed throughout most of the martian year. The circumstances that allow a limited storm to become a runaway or encircling storm are not well understood. Seasonal effects are apparently just one aspect of these circumstances, but apparently a critical one. Dust activity seen by Viking near the edges of the receding cap and data showing that the cap may be receding at a faster rate prior to these storms suggest that the seasonal south cap may be influencing dust activity.

We have also determined that the north polar hood recedes during major dust storms, but it is not clear whether impending storms might have an effect upon this atmospheric phenomenon. Viking images do show local storm clouds near the hood prior to the first 1977 planet-encircling dust storm, but the hood is such a dynamic feature that minor changes may not be meaningful. We are, however, continuing to analyze these data.

Several datasets indicate that Mars' atmosphere was less clear before the first 1977 encircling storm, although we cannot discount the possibility that this was merely a seasonal change. Data from other Mars years are less detailed and comprehensive, but the 1977 Viking data from both imaging [3] and infrared [4] suggest that dust in the atmosphere was increasing prior to the storm. Peter Boyce found that, prior to the 1971 planet-encircling storm, there was "violet haze" present on Mars. He attributed this to the impending storm, which may have been correct, but this condition, which could be due in part to atmospheric dust on Mars, is not uncommon at times when no storm is on the way. This may also be true for other indicators of increasing atmospheric dust mentioned above.

Capen also believed that smaller, precursor storms occurred before a planet-encircling storm. This generally seems to be the case, although the data are not conclusive. These earlier storms certainly provide a good vehicle for raising dust into the the atmosphere and regional dust storms may be a sign of an impending larger storm. However, many of these storms occur without any subsequent dust activity, even during the dust storm "season."

Investigations of dust-storm observations show that that the Hellas Basin is the most active area on Mars for all sizes of storms [2]. This area is probably their primary dust source.

Earth-based observations suggest that, during the expansion phase of planet-encircling storms, diurnal cycles often begin at Hellas, presumably with a new load of dust, as mountain climbers return to a base camp for more supplies to be cached along their route. Each day the storms carry an increasing supply of dust farther to the west, until Hellas is reached from the east, completing the